Spring 2019

PHYS 780-002: Applied Optics

John Federici

COURSE OUTLINE ST: Phys 780 Applied Optics Spring 2019

Instructor: John Federici, 973-596-8482, 474 Tiernan Hall, federici@njit.edu
Office Hours: Tuesdays and Thursdays 9-10am or by appointment
co-REQUISITES: Phys 621 (Classical Electricity and Magnetism I)
COURSE MATERIAL:

- *Fundamentals of Photonics*, 2nd Edition, B. E. A. Saleh and M. C. Teich. Note: you can borrow the NJIT's library online book for brief periods of time.
- MATLAB (available for download from NJIT web page) or similar analysis and plotting software.
- An alternative, advanced undergraduate textbook (purchase is not required for course). *Physics of Light and Optics* by Peatross and Ware (This textbook is available FOR FREE on the web) http://optics.byu.edu/textbook.aspx.

ATTENDANCE: It is expected that students will attend all lectures and recitations. If you anticipate an absence, please let your instructor know immediately. Absence from class DOES NOT alter the deadlines for turning in assignments.
HELP: Visit or email your instructor if you are having trouble with the course; do not simply hope for a miracle and fall further behind.
GRADING: Your final letter grade will be based on a composite score for term's work that includes the mid-term, final exam, and homework.

- Homework - Homework assignments are given in the syllabus below and are due weekly. Late homework will NOT be accepted.
- Mid-term Exam - The date and location of the mid-term exam TBA.
- Final Exam - A NON-**Comprehensive Final Exam will be given** during Final Exam Period .

Final Letter Grades : Here are the approximate weights to be used for calculating the composite score:

- **30%** for mid-term exam
- **35%** for the final exam
- **35%** for the homework

The cutoff percentages for various letter grades will be in the range of 80% for A, 75 % for B+, 70% for B, 65% for C+, 55% for C, and D or F below 50 %.
HONOR CODE STATEMENT: NJIT has a zero-tolerance policy for cheating of any kind and for student behavior that disrupts learning by others. Violations will be reported to the Dean of Students. The penalties range from a minimum of failure in the course plus disciplinary probation up to expulsion from NJIT. Avoid situations where your own behavior could be misinterpreted as dishonorable. **Students are required to agree to the NJIT Honor Code on each exam, assignment, quiz, etc. for the course.**
NOISE and DISTRACTIONS: Turn off all cellular phones, wireless devices, computers, and messaging devices of all kinds during classes and exams. Please do not eat, drink, or create noise in class that interferes with the work of other students or instructors. Creating noise or otherwise interfering with the work of the class will not be tolerated.
Assignments: You are responsible for all weekly reading and homework assignments listed in this outline. The reading should be completed BEFORE class each week. Homework assignments MUST be turned in ON TIME. Homework assignments are due WEEKLY. ALL

ASSIGNMENTS not turned in by the assigned date will be scored as a zero. **Each student must turn in individual Homework assignments. No group submissions will be accepted.**

EMail/ Alternative Methods of Delivery Policy: The instructor is not responsible for assignments turned in outside of class time (in my mailbox, under my door) or not delivered by email. If assignments are delivered by email, it must be date stamped BEFORE the due date/ time. I will log them in when I receive them. THE INSTRUCTOR IS NOT RESPONSIBLE FOR LOST EMAILS, COMPUTER CRASHES, ETC.

Groups and Working Together: You are encouraged to help each other with homework assignments. With regards to homework assignments, you are encouraged to work together if that method helps you learn the material. However, remember that you must understand the homework assignment well enough that you can do it BY YOURSELF on the exams.

LEARNING OUTCOMES: For this course, you can expect to be assessed on the following learning outcomes:

1. Comprehend basic concepts of light propagation using the concepts of Ray Optics (geometrical Optics). Apply these principles to the description of light propagation through mirrors and lenses using paraxial rays. Extend the description of light propagation to matrix optics.
2. Comprehend the basic concepts of wave optics including the representation of light using monochromatic waves. Using wave optics, describe the reflection, refraction, and transmission through optical components.
3. Comprehend the meaning of the equations governing wave propagation as it applies to interference and diffraction. Apply principles of interference and diffraction to analyze these effects in several model systems including thin film interference, interferometry, light propagation through small holes, and image formation (spatial resolution). Calculate unknown quantities based on physical relationships, initial conditions, and known quantities.
4. Generalize the concepts underlying light propagation to an electromagnetic treatment of light as Gaussian Beams. Use the parameters of Gaussian Beams to describe the change in the beam size and wavefront curvature as the beam propagates.
5. Generalize the concepts underlying light propagation to an electromagnetic treatment of light using Maxwell's equations.
6. Comprehend the meaning and origin of absorption, dispersion, and color.
7. Comprehend the meaning and mathematical representation of electromagnetic wave polarization. Explain the difference between linear, circular, and elliptical polarization states, and how the polarization state of light can be manipulated using reflection and anisotropic (birefringent) materials.
8. Extend the concepts of matrix theory of transmission and reflection to dielectric layered media.
9. Describe basic concepts of statistical optics including temporal and spatial coherence and its relationship to the light spectrum.

Accommodations for Disabilities: If you need accommodations due to a disability please contact Chantonette Lyles, Associate Director of Disability Support Services, Fenster Hall Room 260 to discuss your specific needs. A Letter of Accommodation Eligibility from the Disability Support Services office authorizing your accommodations will be required.

The table below shows the weekly topics, reading assignment, and HW problems. Under HW problems, any section which is UNDERLINED has a downloadable file for that week's material. When you click on the link, select the appropriate week's assignment.

Week	Topic	Text Assignment	HW Problems
1	Ray Optics	Ch 1, Sec 1-3	Problem Sheet 1(including HINT for 1.2-1) Ex: 1.1-1, 1.2-1, 1.2-4 Prob: 1.2-7, 1.2-10
2	Ray/Matrix Optics	Ch 1, Sec 4	HINTS for Problem 1.4-5 Ex 1.4-4, 1.4-5, 1.4-7 Prob: 1.4-8, 1.4-9
3	Wave Optics	Ch 2, Sec 1-4	Ex 2.4-1, 2.4-3, 2.4-6 Prob 2.2-4, 2.4-8, 2.4-10
4	Interference	Ch 2, Sec5-6	Ex: 2.5-1, 2.5-3 Prob 2.5.5, 2.5-6, 2.6-2.
5	Beam Optics	Ch 3 Sec 1,2	Ex 3.1-1,3.1-3,3.2-2 Prob: 3.1-6, 3.2-6, 3.2-7
6	Beam Optics (continued)		
7	Fourier Optics	Ch 4, Sec 1-3	Ex. 4.1-1,4.2-1,4.2-2, 4.3-1, 4.3-3 Prob: 4.2-3
	MIDTERM EXAM		
8	Fourier Optics/ Image formation	Chapter 4, Sec 4	Prob: 4.3-4, 4.4-2, 4.4-3, 4.4-6, 4.4-7
9	Electromagnetic Optics	Ch 5, Sec 1-4	
10	Electromagnetic Optics	Ch 5, Sec 4,5,7	Ex. 5.5-1

			Prob: 5.4-1, 5.6-2,5.6-3
11	Polarization Optics	Ch 6, Sec 1-3	Ex. 6.1-1, 6.2-2 Prob: 6.1-5,6.1-7, 6.1-8, 6.2-4, 6.2-6, 6.2-8
12	Polarization Optics	Ch 6, Sec. 4-6	Problem Sheet - Polarization Optics Prob: 6.3-1, 6.3-3, 6.3-5, 6.6-1
13	Layered Materials	Ch 7.1	Prob: 7.1-2, 7.1-3, 7.1-5, 7.1-6
14	REVIEW for FINAL		